Chapter – 6: Methods of Collection of Insects

Techniques for collecting insects are varied. However when collecting insects, we should remember/ keep in mind the following:

a) Certain methods and traps are used to collect only certain specific types of insects from their particular habitats. Thus, the requirements for collecting aquatic insects from rivers, streams, vegetation etc, would differ from those for collecting terrestrial insects from trees, soil, debris, etc.
b) The collecting method thus selected does not only depend on the insect type or group to be collected, but it also varies with the need of collecting live or dead insects.
c) The collecting method being chosen and the collecting supplies required also varies with the time of the day, collection would be carried out, thus, requirements vary for collection during the day from that at night.

Categorising the Methods of Collection:

The methods used for collecting insects may be divided into two categories – Active and Passive. In the first category, the collector is involved in an active search in finding out the insects either by hand or by using the apparatus suited according to one's needs. In the second category, the traps of different kinds are employed to do the work, and the collector participates only passively. Such traps are established at sampling stations in the field, and are serviced at given intervals. In sampling the biodiversity of insects, there is more use of the passive methods than the active methods, although the latter proves valuable in collecting certain insect groups. Large number of insects might be collected, if the collector opts for passive methods.

Active Collecting Methods:

Hand Collecting

When insects are collected by hand then one should have good knowledge or proper information as to which insects bite and which sting, and how far such attack can prove to be poisonous. "Caterpillars with spines or hairs on their bodies should be avoided because some of these have venom associated with these structures." (Drees, 1998, Hand picking, aspirators and tweezers section). In case of collection by hand, the collector should be well equipped

with tools like – hatchet, knife, small garden shovel, forceps, brush, gloves hand-lens, pocket knife, etc. The Isoptera section of the Zoological Survey of India, Kolkata use camel hair brush to hand pick the termites, during their field expeditions. Tools like hand axe, shovel and forceps, are a must in their kit, before they set out for collection. (Plate 6.1)

Hand collecting is useful for large but sedentary or slow-moving insects. Insects found in places such as under logs or rocks/ stones or loose bark or in buildings, in crevices or beddings or timber, or in dung, or in different parts of the plants or in any other location where using any larger equipment is not possible, must be collected by hand. If properly looked for using magnifying glasses many insect specimens would be easily found on plants, which act as their food source, shelter and a place to lay their eggs as well. The wingless Phasmids are handpicked from their specific host plants in the Orthoptera section of the Zoological Survey of India, Kolkata. Also, the short-horned grasshoppers (Family: Acrididae), are easily handpicked from their specific host plants – wheat, paddy, banana and plants of the Leguminosae family. Not only are insects found under loose bark, many also occur in the crevices of the rough bark of trees. To collect such insects one needs to brush the bark with a soft brush, dislodging them into a receptacle of choice.

At times insects from litter and soil might be collected by marking a quadrat of 0.5 - 1.0 m^2 (or any area as convenient) in the field. The litter and soil should be processed through a range of sifters to break up the debris and separate the insects from it. A behavioural extractor might also be used to remove the organisms. These insects are collected by hand using the appropriate tools, just as they move. The Orthoptera Section, Zoological Survey of India, Kolkata, informed that earwigs (Order Dermaptera) are collected by hand from moist leaf litter. Hand picking method is used by the Bombay Natural History Society and the Chhattrapati Shivaji Maharaj Vastu Sangrahalaya, both in Mumbai. The Regional Museum of Natural History in Bhubaneswar and in Mysore, also handpick the required insect groups. Beetles, especially the ground beetles are handpicked by the Government Museum, Chennai.

Aspirators

Aspirators also known as 'pooters' (in England) are effectively used to capture small insect specimens in a convenient way. Insects that rarely fly might also be easily collected using this device. It consists of a glass or Perspex (plastic) or celluloid vial/ jar/ bottle or test tube as required, of the desired diameter and length, fitted or sealed with a cover; two pieces of rigid tubing of either glass of metal (copper) or plastic, one short and the other long (length of the two should be relative according to one's requirements); a cover, i.e., lid or stopper of cork or rubber or any other kind of cap, provided with two holes in which the tubing will fit properly, and a piece of flexible tubing of either rubber or plastic, with a diameter just large enough to fit tightly over one end of shorter piece of the rigid tubing. The shorter length of the rigid tubing should be bent, into a 30º-45º angle. The longer length one should be bent to a 90º angle. The longer tube should extend down to within about one inch of the bottom of the vial or jar test tube used, when in proper position. To the free end of the shorter tube attach one end of the flexible tubing. To the other end, of this tube, is attached a small piece of cloth mesh such as cheese cloth/ a piece of muslin or fine wire mesh, like a bit of an old net bag/ gauze or metal screen. This is done using solder, glue or rubber band or any other thing that would hold the screen in place. This arrangement serves to seal the suction tube on the inside so that insects or bits of dirt or fungus spores or noxious fumes are not accidentally inhaled into the mouth of the collector when using the aspirator. With the free end of the flexible tubing in the mouth and suck sharply, moving the end of the longer glass tube pointing close to the small insect specimen desired to be collected. The specimen will be pulled in by the vacuum created in the container. The sucking type aspirator might be converted into a blow type aspirator by removing the longer length of the rigid tubing and substituting it with a T-shaped attachment. Bombay Natural History Society, Mumbai uses aspirators, during collections from the field. (Plate 6.2)

Large vacuum devices called Backpack Aspirators can remove insects from crops. Some huge tractor mounted vacuum devices have also been developed.

Beating

Wingless and/ or non-flying ad slow-moving insects can be easily collected using a beating sheet/ tray. Well camouflaged or hidden species of insects resting/ securely perched on bushes/ shrubs/ trees, thus, those difficult to be easily spotted, might be conveniently collected through this technique. A beat sheet can be a bed sheet, an inverted, light-coloured umbrella, or it can be made using canvas or heavy duty cloth, preferably white, either of which should be sturdy and durable in nature. The piece of canvas or cloth, usually square-shaped, is stretched across a framework constituted by two diagonal pieces of flexible support rods or poles in turn, made out of any light wood or bamboo or any metal. These are fitted into the pockets at each corner of the cloth. Such arrangement allows the cloth to be rolled up for transport and storage. When using this, it should be held by the 'X' created at the intersection of the rods/ poles. A hand-held beating sheet consists of a shallow canvas bag, preferably white, stretched over a folding frame. Instead of cloth, off-white card such as yellow paper-pad, might also be used and are known as beating cards.

In the beating method, whatever be the type of the beating sheet used, it is held under the vegetation (from which insects are to be collected) with one hand, while the vegetation is either shaken by hand or struck hard using a stout stick or rod or a bat or club. As a result of the beating, the insects in the different parts of the vegetation would be dislodged and fall on the beating sheet used. (Picture 6.1)

Sifters

Sifters are used for collecting concentrated quantities of litter and soil, containing many insect species. Sifters might be of different kinds. One kind has two hoops of heavy metal, each with a handle. A canvas bag or fancy folding bags made with tent material absent (3 - 4) feet in length, is sewn to the top hoop. "The bag is left open at the end and secured with a cord ..." (Schauff, 2005, p. 11.). The second hoop is sewn to the canvas, at a depth of 1 foot inside the bag and to that is attached a rounded metal screen. Another kind might be a simple cat litter pan or a sifting pan. It has either a sifting tray that fits over the litter pan or a wooden tray with hardware screen. To use the sifter, remove the layer of humus/ soil/ litter found immediately below the layer of

leaves and put it into the sifting pan. The litter is then shaken back and forth, forcing the smaller particulate matter and insects into the bottom tray or over a white pan or a piece of white cloth. When the litter or soil or humus reaches the desired level, it is put into plastic Zip-lock bags, or inside cotton pillow cases, preferred, as the insects might get killed inside the bags, even before they could be extracted.

Separators and Extractors

A modification of the sifter is a separator. According to Schauff (2005, p. 11.), “These devices usually depend on some physical aid such as light, heat, or dryness to impel the insects to leave the foreign matter.” The simplest of such devices is the sweeping separator. This consists of a cardboard or a wooden box fitted with a lid. Using a screw or a nail, a glass jar should be fitted to a hole made on one side of the box near its’ top. Once the litter is dumped into the box, quickly close the cover. The insects in the darkened box soon will be attracted to the lighted glass jar. A sophisticated version of this consists of a cloth collecting bag lined with a magnet on top, provided with a clear plastic top and sitting on a three-legged stand made up of aluminium. When the catch is dumped into the bag and the lid is put in place, slowly the insects get attracted to the top and collect on the plastic.

The next group of such devices include the Berlese Funnel, the Tullgren Funnel (similar to a Berlese Funnel although simpler) and the Moczarsky-Winkler sac (a variation of the Berlese Funnel, with a difference). A Berlese or a Tullgren funnel is a closed funnel system, that takes “… advantage of the fact many of the insects to be extracted are negatively phototoxic i.e. avoid light.” (How to collect, 2011). Either consists of a metal or plastic funnel with a gauze tray or a coarse screen of wire mesh 0.25-0.50 inch, on top of the funnel. The screen might also be placed inside the funnel. The sample (litter) is placed on the tray or screen. Positioned the funnel in between a container (jar or vessel) with a liquid preservative below and a source of electric light, suspended at about 10 cm/ 4 inches above the top of the sample – the arrangement should be such that the tip of the funnel should rest in the jar, above at least 2 inches of the preservative (Ethanol is best suited for the purpose). Generally, (70%-80% ethanol with 5% acetic acid is used). To create a steep gradient of temperature

and moisture through the sample is the objective of this set up (Marshall, Anderson, Roughley, Pellletier & Danks, 1994, Sampling methods: active collection techniques section). After the incandescent light is turned on, the litter dries out. Moreover, the heat and the light from the lamp forces the small insects in the material to escape by burrowing down further into the material, past the wire mesh, down the funnel, into the jar of alcohol. In order to dry the sample and drive the insects out of it, heated coil or jacket might also be used around the funnel. The insects begin to move out from the litter within an hour or so; for better results it would be wise to leave the set up undisturbed for a few days. The larger insects if any, gets caught in the mesh.

The Moczarsky-Winkler Selector/ Elector also known as photo elector is another device for extraction and works on the same principle as the funnels (described above). Moreover, the set-up is also similar, except the requirement of any artificial source of light. The funnel is usually replaced by a canvas bag. In this device, "... an open jar, with a moist cloth or tissue inside, is attached to the bottom of the funnel or canvas bag and insects are attracted to the light and humidity." (Schauff, 2005, pp. 12-13.). This device also referred to as the Winkler Sac being made up of fabric, can be kept folded when not in use, thus, saving a lot of space. "Sieving is another way of extracting specimens from a habitat … Any frame with a wire mesh, can be used ...The size of the mesh will depend on the size of the specimens being sought." (Millar, Uys and Urban (2000, pp. 42-43.). The sample after being placed on the wire mesh, the sieve is shaken, preferably over a white surface. To extract insects from sand, a kitchen sieve might prove useful. For mud-dwelling insects, buckets or wooden frames with screens on the bottom are used. The muddy sample might be washed free of soil, while remaining immersed in the bucket, or using a stream of pressurized water – "Larvae will either float to the surface... or can be removed from the screen after rinsing." (Drees, 1998, Turf Sampling section). To separate insects from litter/ debris, in case the sample is collected in alcohol, the use of screens is necessary. (Picture – 6.2; Figures 6.1 & 6.2)

Soil Washing/ Floatation Samplers

To collect the insects in arid/ deep/ mineral soils with high clay content, this is an effective technique. Soil washing requires the ratio of water to soil to be

about 4:1. This technique provides the complete life-history data of the insects collected. The tendency of many insects to either float naturally or in salty water (for example, a saturated solution of Epson salts), is used when collecting using floatation samplers. Picture 6.3

Knockdown Using Chemicals or Irritating Liquids

Using insecticides containing pyrethrins, insects dwelling in individual trees (for examples, fruit trees), specific parts of trees or in a specific volume of canopy (especially, tropical forest canopy) the target area is sprayed or fogged with the desired insecticide, the insects affected fall onto the container below used for collection. Soapy water prepared with one to two tablespoons of liquid dishwashing detergent in one gallon of water, irritates insects. Using a watering can, the liquid can be sprinkled over about two square feet of turf. Within a few minutes, insects would crawl out of the thatch. (Picture 6.4)

Vacuum Sampling

Widely used power suction samples include “D-vac” (Dietrick, 1961) and “McCoy Insect Collector” (McCoy and Lloyd, 1975), are used to collect insects through vacuum sampling.

Grubbing

Removing the grass from selected area and sifting through the soil underneath the layer of thatch, white grubs (the immature stages of beetles), might be collected.

Pupa Digging

This method requires a trowel, for digging and to lift the material containing the specimens. The insects are ultimately sorted out on a water proof white sheet.

Creating Attractive Habitats

For butterflies, in-house butterfly gardens are being built, as has been done at the Science City, Kolkata and at the Bannerghatta Biological Park, Bengaluru. For other insects, the collectors can create attractive habitats. Wooden stakes hammered into the ground attracts the worker class of termites.

Nets

The net is a very handy tool and considered a much valuable equipment for collecting insects, of the three commonly available insect nets, i.e., aerial of butterfly net, sweeping net and the aquatic net. The nets might be used for collecting insects by intercepting during their flight, or by quick clamping over an insect when at rest on the ground, or by moving the net back and forth through the selected vegetation. Basically, a net for collecting insects is made up of three parts. A bag made up of cloth or fine mesh, attached to a wire hoop, in turn affixed to a handle or pole made up of wood or metal. Nets are available in different sizes, where the circumference of the hoop and the length of the handle are usually variable. A variety of nets are useful for various situations. Making a net for collection is advantageous because the size and the shape would be according to the needs of the collector and shall not prove expensive. Piece of stiff heavy (about 8 gauge) steel wire or steel strap for the rim, bent to form a ring, also known as hoop or loop. Aluminium strip might also be used for this frame. This ring varies in diameter, the commonly used range is 12-18 inches, i.e., 30-45 cm. Although smaller nets with diameter of 6 inches (15 cm) are useful in some types of collection, and nets larger than 38 cm in diameter are considered cumbersome at some times. The length of the wire is about 4 feet. The hoop should be a proper round, for this the wire used might be wrapped around a cross of wood. For the collecting bag some strong yet soft, light weight and light coloured fabric is preferred. Whatever be the material, air should be able to flow freely through it and it should be easy to see through it. Dacron is a strong fabric, Marquisette, organdy or netting with nylon or orlon or any fine mesh is usually done. Brussels netting is the best choice, but usually difficult to obtain. Whatever be the material, it should be 1.5 to 1.75 times the rim diameter in length, after folded double. Strip of durable material as calico or muslin, or light canvas, or any tightly woven cloth long enough to encircle the rim of the net. Doweling (straight made up of hardwood), about 3-5 feet, i.e., 100-150 cm in length. Usually the standard length of the handle is 4 feet. It should be around 20mm in diameter. A metal (aluminium) handle is usually recommended. The length and material should be according to the collector’s needs. Tape (plastic/ fibre) or wire is required to cover tightly the ends of the rims where they enter into the handle. Instead a close-fitting metal sleeve (ferrule) to be fixed using a small round-headed screw or a 4 inch aluminium

slip collar, might be used to keep the rim in place (i.e., properly attached to the handle). The researcher has found that 13 museums and/ institutions, use net(s) as a mode of collection of insects, amongst all visited for the purpose of research. These are – Indian Museum and Science City, both in Kolkata; Bengal Natural History Museum, Darjeeling; Regional Museum of Natural History in Bhubaneswar and Mysore; National Museum of Natural History, New Delhi; Entomology Division, Forest Research Institute, Dehradun; Bombay Natural History Society, Mumbai; Government Museum, Chennai; Gass Forest Museum, Coimbatore; Orthoptera and Coleoptera Sections of the Zoological Survey of India in Kolkata. This data has been represented in the Table 6.1, alongside the corresponding chart.

Type of Nets:

Aerial/ Butterfly Net: Minor variations are required from the usual construction, as it is designed to collect specific groups of insects, namely – dragonflies, butterflies, moths, bees, wasps, flies, some smaller insect varieties, etc. The collecting bag is usually white in colour. Nets with larger hoops (as wide as the arm is long from the elbow to the finger tips) are preferred to collect the larger and faster insect groups – Odonates and Lepidopterans. For butterflies, longer handles are also preferred for easy manoeuvring and to reach out. Nets with smaller hoops are good for collecting the remaining of the insect groups. In order to collect such insects when flying, the net should be swung rapidly, then, with the twist of the wrist at the follow-through, the specimen gets entrapped into the bottom of the bag. So as to collect insects when resting on flowers or on the ground, the downward stroke, brings down the net quickly on top of the insect, which fly upward, seeking light towards the tip of the collecting bag. Holding the tip of the bag pointing towards sunlight, or flipping it over the rim, will entrap the frightened specimen and prevent it from escaping.

Sweep Net/ Beating Net: This type of net also follows the basic steps of construction of an insect net, but it is made up of much heavier, sturdier and a more durable material such as canvas or thick cotton cloth or strong muslin. Moreover, the rim of the net might be covered with plastic or heavy fabric. The handles are also much heavier. This net is used to collect grasshoppers, bugs, beetles and chewing and sucking insects of varied sizes. Sweeping is done

back and forth through dense and rough vegetation, along sand and seaweed on beaches, up and down tree trucks, grass of meadows, abandoned fields, etc. Most of the museums using nets, did not specify the type, but the Bombay Natural History Society, Mumbai uses both butterfly and sweep nets. Regional Museum of Natural History, Bhubaneswar uses the sweep net and at the Bannerghatta Biological Park in Bengaluru, the butterfly net is used. (Plate 6.3)

A different type of net, i.e., a large mosquito net was used to cover quite a big (living) nest of hornet wasp, by the Regional Museum of Natural History, Bhubaneswar. For getting hold of bees, wasps and butterflies, net with a fine mesh is used at the Government Museum in Chennai. (Plate 6.4)

Passive Collecting Methods:

Traps

Anything that impedes or stops the progress of an insect is referred to as a 'trap'. The factors affecting the performance of a trap include construction of the trap, location of the trap, time of the year or day chosen for trapping, weather and temperature on the day of trapping, kind of the attractant used, if any. Due to various reasons for instance, the type of insects being collected and their different habitats, we might have different kinds of traps. Only two museums, i.e., the Bombay Natural History Society, Mumbai and the Government Museum in Chennai, use traps for their collections.

Funnel Trap

The trap consists of an electric light source, with a funnel at the bottom directed either into a killing jar or a dark box, positioned below the funnel, to prevent the escape of any insects.

Lindgren Funnel Trap

It consists of a series of black funnels suspended one on top of the other from the branch of a tree, or from a rope suspended between two trees. At the bottom of this arrangement is a container with an appropriate liquid preservative (either ethanol or ethanol/ propylene glycol mix), to receive the trapped insects. This trap might also be used with baits such as turpentine or any other attractant, like pheromone.

Lobster or Eel Trap

Known as 'Reuse' in German, this trap includes any container having an open end that is fitted with a shortened cone directed inward with a liquid preservative, or having a funnel fastened into its open end will make a lobster or eel trap. Modified versions of this trap are the Steiner and Mc Phail traps.

Colour Traps

Different groups of insects are attracted to specific colours. This fact has been used in developing devices and techniques for trapping and collecting insects.

Yellow seems to be the most widely used colour to serve the purpose as most of the insects are attracted to this colour (especially Homopterans, micro Hymenopteran groups, aphids, white flies, etc). Another colour finding good use is blue. Leaf miner flies, fungus gnats, thrips, parasitic wasps, etc, are attracted to this colour. Red is also attractive to certain insect orders. White and black can also be used in such traps, as some groups of insects show affinity for these colours. Dipterans show attraction to the colour white, whereas, horse and deer flies get attracted to black coloured traps.

Pan Trap/ Yellow-Pan Trap/ Moericke Trap: In this trap, small, shallow pans, mostly yellow in colour (usually on the inside) filled with a liquid (water mixed with a surfactant like, salt/ soap/ detergent, i.e., any reagent that breaks the surface tension of water), is used to trap insects. The pans might be replaced with bowls, plates, trays and food distribution containers. Besides yellow, blue or white or red might also be used. The preferred dimensions of the container might be 15 x 17 cm whereas diameter might be 40 cm, volume might be 500 ml. Smooth surface is desired. To use this trap, the container partially (up to one third) filled with liquid (of type and material as chosen by the collector) might be simply placed on the ground/ substrate surface or it might be set into the substrate, i.e., a depression is dug in the ground and the pan is placed into it. When the traps installed flush with the soil surface the entomofauna collected varies from that collected when the traps installed flush with the litter surface. Insects might get entrapped by this trap either by getting attracted to the colour of the pan or to the appearance of the fluid surface. These traps should be checked at least once daily or strained periodically. Using a strainer (usually, fine-mesh) aquarium net, the insects trapped are obtained. Then the

specimens are rinsed gently with water before exposure to any preservative. (Picture 6.5) At the Bombay Natural History Society in Mumbai, yellow pan traps are used to collect insects.

Coloured object/ Sticky Trap: In this type of trap a piece of tape, simple plastic disposable drinking cups, a cylinder, any square piece of object like a board, cards, a pane of glass, a piece of wire net, or any other object is required. If square, the object should be 15 cm on one side, if cylindrical, the diameter should be about 15 cm and the object should be 20 cm in length. The object is usually painted yellow, attracting diverse groups of insects, and coated with a sticky substance such as ‘Flytac’, Tangle foot (available in spray or gel formulation), etc. Then this object is either suspended from a tree branch or other convenient thing, or it is attached to a pole. Insects attracted to the object, is unable to extricate themselves once they come in contact with the adhesive surface. In order to release the trapped specimens, a suitable solvent must be used, like toluene, xylene, ethyl acetate, or various combinations of these. Adhesives used might be either grease-based or resin-based. Another kind of coloured sticky trap is the Manitoba trap having a black sphere to attract members of the Tabanide family (horse-flies), which are finally captured using a canopy-type trap.

Yellow Sticky Strip: Usually 11.5 inches X 6 inches, thin strips made up of plastic, bright yellow in colour and coated on both sides with a non-toxic, non-drying sticky substance. These strips are covered on either side with a removable waxed-paper. A hole at any one end of these, enable them to be hung from any desired position/ point. Such strips might also be used by being taped on to the floor. In such cases only the top side wax paper is removed and the strips are baited with a small amount of fish feed, available commercially. (Picture 6.6)

Pitfall Trap

Pitfall traps are another kind of trap employed by the Bombay Natural History Society, for collecting insects. A pitfall trap consists of some type of cup or container like plastic buckets, jam tins, glass jars, can, dish (450 ml glasses, plastic bowls) or plant pots, metallic containers, usually of aluminium. To use

the trap either of the above options might be chosen (as suitable to the collector), and buried into the ground, at a depth greater than that in the case of pan traps; in a manner that the upper rim or lip or the top edge of the container, flushes with the ground/ soil surface. The best pitfall trap would be one that uses two containers of the desired diameter and depth, such that one of them fits into the other. One of the containers, remain completely submerged into the ground throughout the operation. It also receives the extra rain water and keeps the other container afloat. This prevents the loss of insect trapped from the latter and also allows the easy removal of the specimens thus collected. Coating on the inner vertical surface with a "slick material", or a light dusting of talcum powder, will disallow the insects any kind of escape from the container, once that have fallen into it. Before being sunken into the ground, the container selected is filled with a preservative/ killing agent at the bottom but only partly. Salt water, water with a drop of liquid soap in it to form soapy water (soap acts as the surfactant), 70% ethanol, or ethylene glycol, might be used. "The best all-round preservative is propylene glycol ..." (Davies, 2003). The modern environmentally safe automotive coolant, also known as antifreeze will thus, serve the purpose. Before using, it should be diluted with water. A mixture of propylene glycol and 70% ethanol used in equal ratio, with a pinch of dentonium benzoate (to avoid mammals being attracted to the solution) might also be useful. During periods of little rain, a 50/50 mixture of propylene glycol and water serves best. More of ethylene glycol is preferred, during periods of frequent rain. The pitfall trap becomes more efficient with use of guiding vanes/ funnels/ baits/ barriers.

Flight - Interception Trap (FIT)

Also known as barrier trap, this trap is used to collect small, weak flying species of insects; those fly upwards or fall downwards on being intercepted by a barrier into a container of some type, which is partially filled with a suitable liquid preservative/ killing agent. Mainly this may be two types:

1) **Malaise Trap:** These traps resemble a tent, with two open ends or have two short end walls, one central wall and a roof that is peaked at only one end to from a sloping canopy, leading upto a collecting jar/ killing bottle. Usually, the trap is made up of fine mesh material or net. The side walls if present are generally black and the roof is white. The central wall also referred to as the interception panel or the barrier is a piece of screen or Plexiglas or a vertical

net/ gauze/ mesh, usually black. It may be semi-transparent also. The reagent used in the retaining device (collecting bottle/ killing jar) is usually alcohol, to preserve the specimens collected. If liquid is not preferred then heat can be used to immobilize the insects. Solid killing agents might also be used, like dichlorphos (Vapona) or DDVP strip might also be used. Vapona is a useful fumigant in case of hairy and waxy insects, which are damaged in alcohol (80% ethanol with 5% acetic acid). The trap is usually 5 feet high in the front peak, 4 feet high at the back. The barrier might be around 6 feet in length and 3-4 feet in width. The set up might either make use of trees or poles (wooden or otherwise), to support the trap at each corner and at the peak in front. The poles are in turn tied with ropes/ strings to wooden sticks grounded at a distance. Usually, these are set up at right angles to an insect flight line. For collecting insects falling downwards, after hitting the barrier. A series of pan traps arranged in a linear fashion, an elongate trough, or a plastic preferably yellow in colour and of heavy gauge, or simply any other container. The liquid preservative used may be a mixture in equal proportion (50/ 50) of propylene glycol and 70% ethanol with a pinch of dentatonium benzoate. The original design of the Malaise trap, was developed by and so named after the Swedish entomologist Dr. Rene Malaise. (Picture 6.7)

2) **Window pane trap:** This trap simply consists of a window pane made up of glass or plastic or gauze or cloth, which is held vertically upright, either using wooden poles fixed to the ground, or by suspending by a line from a tree or from a horizontal line. It is placed across the path of flight of insects, above a trough filled with a liquid killing agent, such as soapy water or ethylene glycol.

3) ***Serrico Cardboard Trap***

This trap involves folding into a box usually 3.5 inches in breadth, 7.5 in length and 0.5 inch in height. On the inside these traps have a covering, in the form of a thin plastic sheet coated with sticky, non-toxic plastic substance. Usually, this trap uses a pheromone as the lure known as “Lasio Lure”.

Suction and Rotary Trap

These traps either pump a volume of air through a filter (Johnson, 1950) or use a mechanically rotated net, to obtain aerial insect fauna. Suction traps collect small slow-moving, fragile, winged insect specimens.

Storgard Trap

Made up of corrugated cardboard, these traps fold into neat, thick blocks usually of the dimensions of 3.5 inches X 3.5 inches X 0.75 inches. Inside such a block is placed a plastic trough, holding a circular blotting paper. On this paper, an oily food bait is placed to attract all such insects which require proteins and salts for nutrition. Being only in nature, the bait coats the breathing apparatus of the captured insects. This leads to the immobilization and ultimately killing such insects within the trap itself.

Paper band Trap

Insects living in crevices of the tree barks might be collected using such traps. These traps utilise bands of corrugated paper about 15 cm wide. Such paper is wrapped twice around the tree trunks and then the band is tied with a string. Such bands are made along the tree trunk at varied heights, and the arrangement is left in this way for several days, to even a month. Insects of the tree bark take refuge in these bands. When these paper bands are removed, they are collected in a plastic bag, already having cotton wad soaked in chloroform to anaesthetise the insects, sorted later on a tray.

Electrical Grid Trap

In this kind of trap, insects are attracted to pheromone or any other kind of attractant which is placed in a chamber, and protected by a strongly charged electrical grid, hence, trapped.

Snap Trap

One of the two kinds of this trap requires a pair of wooden or plastic discs, a pair of rods, a cloth cylinder, a ring, a string, a pair of springs and a pair of latches for its construction. The pair of discs selected, is slotted to the centre to be able to fit properly on a tree branch, and to remain connected with one another using the pair of rods. The cloth cylinder is fixed to one of the discs at one end, and to the ring which is sliding on the rods, at the other end. To collect the insects, once the cylinder has been pulled to either of the two ends, the ring is held in place using the pair of latches. The collector waits for the insects to settle on the particular tree branch, its leaves and flowers. The latches are released, by pulling on the string from a distance, and the trap is snapped shut by the pair of springs on the rods, to capture the insects on that branch. Another is the canopy trap. In this kind, as soon as the latch is released, a

spring-loaded canopy is snapped over an area of the ground, resulting in the capture of all insects in that area within the canopy.

Light

The fact that insects are attracted to light from any source is used to trap insects, especially those which are nocturnal in habit and are difficult to obtain from their hideouts or resting places. Light for example, torch lights and lanterns are use to catch nocturnal beetles and moths, at Chennai's Government Museum. Either a proper trap is constructed having an electric light source, or a light sheet is used against the light source. The light traps might be of different types, depending on the type of light used, i.e., black light or white light and on the type of insects desired to be collected live to be reared, or dead for being displayed/ stored in insect boxes. The size of the specimens to be collected also lead to the variation in the design of the light traps. Different light traps include Box Traps and Funnel traps.

1) **Box Trap:** An actual box-trap is constructed so that it has five solid surfaces, but the sixth is made up of two overlapping sheets of glass, sloping inward to form a narrow horizontal aperture. The side opposite the sixth does not have any opening, preventing the escape of trapped insects. A bottle with the desired killing agent or a spirit lamp might be used to kill the insects entering the box-trap. Actually, insects are guided through the narrow slit-like opening between the two glass sheets, into the box. The fumes from the killing bottle or ethyl - acetate diffused in case a spirit lamp is used inside the trap, gradually immobilizes the insect, or some may crawl to any corner of the box and simply rest there, on rough corrugated or cellular material like that used for egg packing. The **Rothamsted Trap** (Williams, 1948) although having four glass entrance walls also falls in this category of traps.

2) **Funnel Trap:** All such light traps actually make use of the observation that insects attracted to a light source usually settles below it, if possible, or fly around it until they fall down due to exhaustion. The probable types of funnel trap include -

- **The Hiestand Trap:** This is the simplest of the light traps that follows the basic principle, described earlier. Thus, it consists of an open electric light source, with a funnel leading into an open killing-bottle slung below.

- **The Williams Trap:** A combination of the Box Trap and the Hiestand Trap, it was modified so as to be portable for use during field expeditions to collect insects from the natural surroundings.

- **The Robinson Trap:** A new light trap was developed by the two Robinson brothers (Robinson and Robinson, 1950). In their endeavour to build this device they brought to the forefront some new facts about the behaviour of insects towards light. The general assumption is that insects get attracted to light and they fly towards the light source in a more or less purposeful manner. But, the Robinson brothers felt that the fact was wrongly stated. They said that insects are attracted to a very small source of light at a distance, in an isolated dark area, but on nearing a brightly illuminated area, they cease to fly and settle down. If the source of light is distant, the insects are still able to fly straight and maintain the constant angle with the direction of light. But, on nearing the light source, the insect changes the direction of its flight very rapidly, thus, it then moves towards it in an ever-steepening spiral. This British-made trap uses an intense, blue-white 125-watt mercury vapour lamp. It is considered to be the most effective to be used in light traps, as it has certain special qualities, which attract many insects. Although, it is uncertain how safe this lamp is when used at close range, it has been used for many years now, without much negative feedback.
- **The New Jersey Trap:** This trap is designed especially for small, non-scaly insects. This trap uses a motorised fan to force the insects (especially those, without sufficient body weight), to readily fall into a killing bottle, after getting attracted to a light source.
- **The Minnesota Trap:** Similar to the New Jersey Trap, it does not use any motorised fan.
- **The Wilkinson Trap:** Construction wise, this trap is much more complex than the New Jersey or the Minnesota Traps. It has a major difference from these two, in that instead of a killing bottle, it uses a simple collecting bottle, without any killing agent in it.

Different groups of insects are specifically attracted differently to the different types of light. This is due to the different minimal and maximal thresholds of attraction. But the “black light” (Ultraviolet light or near UV light) attract many times more insects and types than the “white light” (the regular light given off by

the standard sources). Soft, yellow lights are usually unattractive to insects, except midges. Again, red light cannot be detected by certain kinds. Ultraviolet fluorescent tubes of power more or less than 15 watts or 15 watt itself emitting visible bluish-white light and the black-light tubes emitting deep purple light, both are considered to be equally effective in light traps. But the mercury vapour lamps used in most cases, are cheaper and easily portable. The trap is generally kept for several days at a time, so presence of a cover is better, usually a transparent plastic sheet is used. Frost (as cited in Hardwick, 1968) concluded that unhooded traps were more efficient than the hooded ones, in collecting many nocturnal insects. The trap size, height and design also determine the type of insects that will be trapped by using a light trap. Besides, the Government Museum, in Chennai, the Bombay Natural History Society (Mumbai) also traps insects using light. The light traps here use mercury light, (ultraviolet) light, fluorescent light or tungsten lamps. The Entomology Division, Forest Research Institute, Dehradun also uses light traps. This is supposed from the fact that a light trap is displayed in the Entomology Museum of the division. (Plates 6.5) Some nocturnal mantids are caught using the light traps, as has been learnt from the Orthoptera section and the Coleoptera Section of the Zoological Survey of India in Kolkata, also use light to catch the beetles.

3) **Light Sheet:** Insects are collected, using a light sheet, especially at night. Actually, a light source is hung downward from the top of a sheet of cloth (acting as the landing surface), preferably white in colour. Insects attracted by the light are usually handpicked from the sheet (which reduces chances of escape) or are collected using a pair of forceps or a killing bottle. The light source might emit black light or fluorescent light or incandescent light, either kind is effective in attracting insects. Instead of any one type of light, some collectors use a "... combination of sources such as ultraviolet fluorescent tubes, gasoline lanterns, or automobile headlights." (Schauff, 2005, p.). To set up the sheet, a rope that has been looped twice, is tied between two trees, so that the sheet can be hung from one loop, while the source of light is hung from the other. The sheet may be pinned to the rope using strong safety pins or by any other means. If trees are absent in that area then light weight metal piping or PVC piping might be used to hang the sheet. The top of the sheet should be within the reach of the collector. The bottom of the sheet should be spread out

properly but should be at some distance above the ground (about one feet). Extra length, if any, might be folded to form a long pocket all along the sheet that holds some of the insects falling into it. The Coleoptera Section of Zoological Survey of India, Kolkata, uses a light sheet. Coloured light does not attract as many insects as white light does, so the latter is used. To collect the insects, a huge polythene sheet on which a sufficiently large bed sheet has been placed, is used. A refinement of the light sheet trap, is a gauze cylinder consisting of a central pole to which light tubes are attached. Where there is no electricity, gas and paraffin lamps might be used. This kind draws insects from all sides of the set up so a greater number of specimens are obtained. (Picture 6.8)

Traps for Collecting Specific Insect Groups

1) **Japanese Beetle Trap:** Named so, because this trap is especially designed to capture Japanese beetles. But this trap is also useful for trapping other beetles like scarabs, cerambycids, mordellids and other insects. The trap is bright yellow in colour. As a further means of attraction, floral attractants/ lures/ pheromones are used in this trap. The trap consists of a screwed jar, filled with 70% ethanol as the liquid preservative. To attract and trap the desired insects, this trap is hung from the branches of trees using a string or rope. (Picture 6.9)

2) **Epps Biting Fly Traps:** These are designed to trap, hence, collect the biting adult stages of insect groups belonging to the Family Tabanidae namely, horse flies and deer flies.

3) **Butterfly Trap:** This trap is designed to capture fast – flying butterflies and those that dwell at great height, in tree canopies, hence, cannot be reached otherwise. To construct this trap is required a gauze cylinder, positioned vertically and closed at the top. Leaving some space from the bottom of the cylinder, a platform is placed. At the centre of this platform some kind of bait (over ripe banana/ rotten meat/ fish/ animal dung) is placed in a bowl. After readying the trap, it is hoisted onto a high tree branch using a rope. Once the butterflies enter into the trap, they alight on the platform, then move to the edge of the cylinder to feed on the bait, ultimately they fly upwards to the top of the trap and settle there.

4) **Cockroach Trap:** This trap consists of a clean and clear jar. A mixture is made using mineral oil and Vaseline. This mixture is prepared to coat the inner

layer of the jar, starting from the top downwards upto a certain distance, into the jar. Inside the jar, a suitable bait in the form of peanut butter and or banana is put, so as to attract cockroaches. This completed trap is placed at any location, frequently visited by these insects. Once any cockroach enters the jar to feed on the bait, it is unable to climb up the jar's vertical inner surface, hence cannot escape from the trap.

Attractants (Baits, Lures and Others)

Collectors have tried to understand this chemical communication system of insects and developed baits and detected different kinds of attractants natural or synthetic to obtain the desired specimens. Such baits might be used by being applied to the ground, on the trees, on ropes/ other suspensions or any other convenient spots. This method helps to collect insects directly from such baits.

Baits

One type of baits includes the products of fermentation and vegetable decomposition. These may occur naturally or prepared using naturally or artificially obtained ingredients.

Brown Sugar Yeast Bait: A mixture of water, brown sugar (2 cups of each) and 1 packet of Brewer's yeast, forms a very good bait. This bait taken in a container is either placed at the base of a tree, or is hung from the branch of a tree.

Beer/ Molasses Bait: A mixture of beer and molasses of equal parts, if prepared in a container (like a bucket) which is then hung from a tree branch, attracts insects.

Wine/ Fermenting Fruit Bait: Cheap red wine, sugar and rotting fruit (like strawberries and bananas) is mixed together in a container (for instance, a bucket), and allowed to remain for some days. This mixture is not made very thick as, a rope is soaked into this and pulled out, such that the rope has this mixture around it on all sides. Then this rope is tied between any two trees, as appropriate, in an area with proper vegetation.

Recipes of Baits Used for "Sugaring": Sugaring is a technique that involves the preparation of a sweet mixture, which is then applied on tree trunks, particularly to collect the nocturnal insects. The bait used for 'sugaring' varies from collector to collector, according to their needs and preferences. Different

Recipes of Baits Used for "Sugaring" are sugar, miscellaneous fruit scraps (especially over ripe bananas) and molasses, used in any combination acts as an effective bait, because it results in obtaining a good catch. Adding beer or rum to the mixture is also preferred by some collectors, to insure odour and an intoxicating effect. Sugar (white or brown), alcohol (beer, wine or a stronger form like rum), vinegar of malt (natural) and molasses, mixed in order to form a semi-fluid paste, attracts a good number of insects. If a liquid mixture is suitable, then a mixture of beer, brown sugar and little vinegar of malt or of wine, with water, serves good. 25% each of beer, vinegar, molasses and white sugar gives a liquid mixture.

Fresh Fruit Sugar Bait: A mixture is made of mashed fruit such as peaches and/ or bananas and a cup of sugar. The container (not airtight) with this mixture is allowed to stand for a week. During those seven days, a little sugar is added to the mixture every day. This is to help continue the fermentation process, which can be further accelerated by adding yeast to the mixture. Before using this mixture as bait, a cup of brown sugar is added to it. The 'Beer/ Molasses Bait' if altered a little in terms of composition, i.e., the ratio of stale beer and dark molasses is 6:8 instead of being equal; finds use in 'sugaring'. The Wine/ Fermenting Fruit Bait, also finds good use in "Sugaring". Either brown sugar & beer is boiled to the consistency of treacle or brown sugar mixed with treacle is thinned with a littler beer. Then, a tablespoon of rum and aromatic like essence of lemon, aniseed or jargonelle peer (very small amount) just before application makes a good bait. At the Government Museum in Chennai, sugar traps help to catch the nocturnal moths and beetles, as is done by them. Usually, the bait (either of the above mentioned recipes), should be taken in a proper container, to retain the stability of the bait and for being easily carried to the field. The container is made up of plastic/ glass/ stainless steel/ enamel ware, etc. Using a paint brush, the bait should be applied in narrow, vertical streaks, covering an area of about 5 square inches. Sugaring should be always done on the side protected from wind. Sugaring gives best results when carried out in twilight conditions especially at dusk, followed by catching of insects at night, but certain insects do get attracted to the bait even during the day. Insects trapped on the baited trees are usually collected into a killing jar containing a killing agent used generally for insects. Generally 'sugaring' is

done at dusk and insects captured are collected once darkness sets in. Another kind of bait includes the nitrogenous products of animal decay. These include:

Carrion Bait and Bating with Excrement: Carrion or small carcasses attract many insects as they like the smell of rotten meat. A specific insect group should be mentioned here i.e. the carrion beetles, as the name suggests these beetles are sure to be trapped using this bait. Excrement from animals such as deer, pig, etc., or even from humans taken on a piece of paper and kept exposed by simply placing on the ground will attract plenty of insects and of different types too. But, a specific group of insects surely attracted and trapped using this bait are the dung beetles. Insects on the carrion or on the excrement might be collected using a net. Collection of insects is also possible using a canopy trap.

Tuna Fish: Tuna fish is another good bait, especially for ants.

Meat: Government Museum in Chennai use meat as a bait to trap moths and ground beetles.

Chemical Attractants:

Turpentine: Turpentine poured into a small jar having a lid and that is provided with either cotton or a wick, such that it runs into the turpentine. The jar is then used combination with a suitable trap (usually, Lindgren Funnel Trap) to attract insects, especially wood boring beetles and bark beetles.

Octenol: Chemically known as Octenol or 1 Octen-3-ol, it's common name is mushroom alcohol. This finds use as a chemical attractant that lures/ attracts biting flies (Diptera), especially horse flies and deer flies. In the present day, these are also being used in Magnet Traps, a device designed to capture and collect mosquitoes. Mosquitoes are attracted to Octenol because the latter mimics human breath.

Carbon dioxide: Warm-blooded animals exhale CO_2, through the physiological process of respiration. Some insects, especially biting flies are attracted to this gas. Dry ice, the solid form of this gas, available for commercial purposes might be used, in insect traps, like in a Malaise Trap. The CO_2 gas emitted attracts the horse flies and deer flies, which get captured easily. Moreover, when treated with an acid, such as vinegar, carbon dioxide, is used as a chemical attractant in Manitoba Traps.

Pheromones: Pheromones are chemical substances, naturally produced and emitted by insects, to serve as a means of communication between them.

These are now being used to attract insects. Schauff (2005), is of the opinion that, "Most pheromones are highly specific, attracting only one species or a group of closely related species." (p. 20.). Many of these behave as sex attractants, i.e., pheromones produced by one sex of an insect type, usually from females are used to attract the opposite sexes, i.e., usually males. Either, pheromones derived from the respective insects, or the live insects themselves are trapped to attract the other sexes of the corresponding types. According to the Isoptera Section, Zoological Survey of India, Kolkata, Pheromone traps might be useful in collecting termites, only if intended to collect for any purpose other than preservation.

Other Lures Used:

The Oatmeal Trail: Dry oatmeal scattered along a path attracts insects (Hubbell, 1956). Specifically, cricket, cockroach and ant groups are lured to the trail. The insects are handpicked or collected using nets or aspirators. For nocturnal ones, a light source has to be used to track insects.

Sounds: To communicate or to attract others of the same kind, insects also produce sounds. The sound produced by a particular species or group of insect is specific, and vary from one another in aspects like pitch, tempo and duration. Either, recordings of the insect sounds are played in the appropriate location at an appropriate volume, or live insects are used in a trap and used as a bait with their sounds, to lure insects of different kinds, especially Orthopterans like grasshoppers and crickets.

Host Animals: Blood-sucking insects belonging to the orders Diptera, Mallophaga, Siphonaptera, etc, might be captured, using host animals (birds, man or animals like horses, etc.) as the bait.

Others: "Hesperid moths (skippers) have been shown to be attracted to small pieces of netted paper placed on vegetation (Lamas et al., 1993)." (Schauff, 2005, p. 20.). "Even a simple vegetable oil soaked piece of an index card (1 by 1 inch) makes an attractive baited card sampler." Drees (1998). Commonly used for this purpose are soybean and olive oils, attracting grease-feeding ants. Paper dipped in oil with a lantern behind it, is a potential trap for moths, and this is used by the personnel of the Government Museum in Chennai.

Collecting Aquatic Insects:

When collecting aquatic insects, a general observation is that a sunny day, with the outside temperatures on the higher side, provides the collector with good results as both adults and the immature stages of aquatic insects get trapped. Different collecting equipment include –

NET: To collect insects many kinds of net might be used depending on the portion of the aquatic habitat the collector wishes to scoop. Water nets must be sturdy in nature, but the rims should be of diameter smaller than those used for collecting aerial or terrestrial insects. The frame of the net varies, depending on the nature of the water body in which the net is to be used. D-frames and O-frames (circular) ones are good options for slow-moving body of water. Whereas, for fast-moving body of water, comparatively larger nets with rectangular frames, are a suitable option. The collecting bag of the net should be small in size and not very deep (only about 1.5 times the diameter of the rim in length). It should be made of thick cotton netting or of synthetic material, such as nylon. The mesh size should be such that it can entrap small insects as well. The material used should be preferably transparent, to be able to view the catch. Nylon is a good option as the netting material, if the appropriate quality (in terms of thickness and porosity), is obtained, also it is easier to dry. To reinforce the cloth bag of the net, the sides might have heavy cloth lining, bands made up of strong material or another bag made of thick canvas might be attached at the top of the net, hanging loosely around it. The shaft or the handle of the net should be strong and long about 1.2 m (4 feet) to 1.8 m (6 feet). The longer the handle, the greater the area it covers in water. The size of the frame and the length of the handle used, varies with the depth of water.

Net Types: When the collector wants to collect from the surface of the water body, then a fish net should be used. This is the one used in aquariums.

Tow Net: For collecting floating insects from the surface of deep water, a tow net is useful. The collecting bag is made up of linen and the frame is circular. Collection using this is carried out by dragging the net through water.

a) **Dip Net:** When the entomofauna of the aquatic vegetation has to be collected, a dip net is to be used. It has a diameter equal to that of the rim. It is made up of either marquisette or bobbinet. To make the net more durable and hardy for use, a canvas bag is attached around the net at the top, such that it hangs loosely. The mesh size of both the material used for the collecting bag

should be such, so that it can be used with ease and prevents the escape of any insects, after being netted. An easy way to construct a dip net is by attaching a plastic or metal dipper to the end of a pole. Insects hiding under submerged rocks and logs might also be collected, using a dip net. Actually, when disturbing the submerged soil or rocks or logs the net should be held downstream to allow the insects to flow into it.

b) Net for dredging: To dredge the bottom of any water body such as ponds, lakes, etc, a net is used. The collecting bag of this net is made up of fine mesh material but this also has a canvas bag loosely attached around it to prevent getting snapped or torn. The base of the pole has a bar for example – an oblong frame of metal to disturb the rocks at the bottom when the net is pulled along the bottom of the water body.

c) Seine Net: A seine net consists of a rectangular piece of netting attached on its shorter sides to two poles. At the time of use, the vertical arrangement of the poles of the net allows them being pushed into the bed of the aquatic body. The rectangular netting is thus spread out across the flow of water. Small insects carried by the current get caught in this net. Moreover, rocks or logs or vegetation or any kind of debris flowing upstream, when intercepted by this netting, any insect present is trapped.

d) Kick Net: In this method, the net should be held in a manner such that the rim of the net touches the bottom of the water body while the net opening is faced upstream. Holding, the net thus, the collector should then kick the water bed to disturb the silt, gravel, vegetation, etc., which then gradually flow into the net.

The dip net and dredge are useful in slow water environments, whereas, the seine net and kick methods are effective in fast moving body of water. (Figure 6.3)

Under-water Light Trap: Hungerford and others, (1955) designed a light trap which could be used in under water expeditions to capture the water bugs, the water beetles and the aquatic stages (nymphs and larvae) of the may flies, dragon flies and various other flies (Diptera). It consisted of a horizontal pipe/ tube, 21 inches in length and made up of galvanized iron. On one end it had a cone, that had a hole, at its apex. It was of copper gauze having 40 meshes per inch. The other end was closed by a wooden plug. This had four pipes of shorter lengths, each of diameters 1 inch, and closed with copper gauze.

Known as 'well traps', these served as, 1) the outlets through which water was drained out when the trap was lifted out of water, 2) the receptacles for the smaller specimens of the catch. Attached to the middle of the wooden plug is water tight killing jar, (provided with a screw top) together with a fitting of a pocket electric torch. In the wireless variety, the big condenser present is used to hold the torch. At a place on the side of the pipe is a lead sinker. Immediately opposite to this is a place for the attachment of a cord. To set up, the torch is powered with new batteries fixed in position and turned on. The killing jar is fixed in place using the adjustable screw. The wooden plug is pushed into the tube and fixed in place using screws or hook bolts. Then the trap is gently submerged into the water using a rope which has markings at suitable lengths. Then markings are done with water proof Indian ink. Lowering the rope, the trap is taken down into the water to any desired depth, and then the rope is secured. To keep the light working under water is the main problem due to presence of underwater vegetation and other sources of obstruction. (Figure 6.4)

Other methods of Collection: Pulling up aquatic plants from small water bodies and leaving them on light coloured trays or sheets is one of the simple methods to obtain immature stages (larvae/ nymphs) of aquatic insects.

Colanders: These are bowls provided with many holes. These can be used to 'scoop' out insects either at the water surface or from the water edges.

Further procedures: Whatever method or the equipment is used for scooping into the water bodies, the material obtained is sifted using pan sifters and sorted using trays, or on sheets both preferably white in colour.

<u>Other Equipment Required:</u> Forceps – for grasping larger insects; Eye droppers – for 'sucking' up very small insects; Vials/ Bottles – These are used in different sizes and with different liquid preservatives like alcohol, kerosene, triton X-100, etc., so as to capture, kill and preserve the aquatic insects collected. Collection from the different depths of water must be kept in separate containers to prevent insects from attacking each other.

<u>Standards in the collection of insects:</u>

1) The governing body of the museum must have a clearly defined acquisition policy, according to which collection(s) if any are to be made. The museum might seek the advice of any national or international body, at the time

of preparation of its acquisition policy. National body in case of Indian Museums might be Museums Association of India (MAI). Internationally recognised body for museums is ICOM (International Council of Museums).

2) The museum's collection policy must state why the museum collects particular groups of insects and undertake collecting activity in particular areas. According to the Museums Galleries and Commission (1992), "It should describe the historical collections held by the museum, and explain how the current biological acquisition policy fits into the museum's overall policy." (p. 11.).

3) The museum must take care of legal, ethical and ecological constraints, if any, while acquiring any insect collection.

4) Any person or group or institution, from where a museum accepts any entomological collection, must adhere to the same set of legal, ethical and ecological constraints. Moreover, the person/ group/ institution, must be aware of and abide by the policies underlined by the particular museum.

5) When a museum collects, it should abide by the laws recognised both, nationally and internationally. For example, It is necessary to consider the "Convention on International Trade in Endangered Species of Wild Fauna and Flora" i.e., CITES. Again, the natural history or multipurpose museums in India interested in having insects as exhibits or to forma a part of their repository must consider the Wildlife Protection Act, 1972; the Prevention of Cruelty to Animals Act, 1960, etc.

6) Every museum interested in insects should collect only those specimens; it has the facilities and the experts to care for. Type specimens and/ or rare and/ or scientifically valuable specimens should be held by a museum only in the presence of qualified and specialised staff besides, the appropriate facilities.

7) "Every museum intending to carry out field work in the biological sciences should prepare a fieldwork policy." (Museums Galleries and Commission, 1992, pp. 36-37.). It should include the following information – the reason for carrying out the field work; the resources (staff, time, equipment and money) required; the expertise and time required to process the data and specimens collected, space and curatorial time required to permanently house and display the specimens (and related staff); and to see whether the fieldwork is at all feasible.

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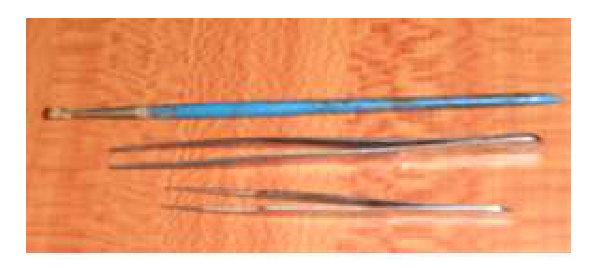


Plate 6.1: **Forceps and brush used at the Isoptera Section, Zoological Survey of India, Kolkata**

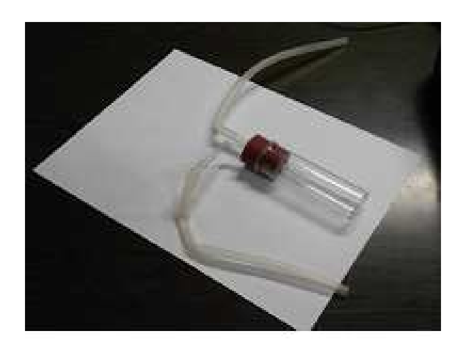


Plate 6.2 : **Aspirator used at the Bombay Natural History Society, in Mumbai**



Picture 6.1 (left): **Collecting insects using a beating sheet**

Picture 6.2 (right): A separation bag

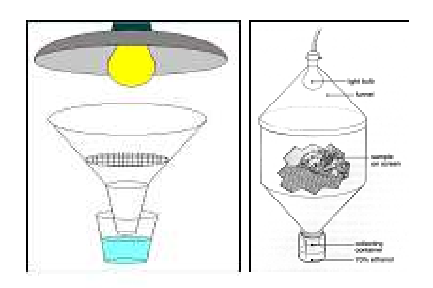


Figure 6.1 & 6.2 (left & right): Berlese and / Tullgren Funnel

Picture 6.3 (left): **A floatation sampler**

Picture 6.4 (right): **Sprinkling irritating liquids**





Plate 6.3 (Top): **Nets with adjustable handles (of different material), used at the Bombay Natural History Society, Mumbai**

Plate 6.4 (Bottom): **Net used at the Government Museum, Chennai**

Picture 6.5 (left): **Yellow Pan trap**

Picture 6.6 (centre): **Using a yellow sticky trap**

Picture 6.7 (right): **A Malaise trap**



Plates 6.5: **Light traps used at the Bombay Natural History Society in Mumbai (left & centre). Light trap displayed in the Entomology Museum, (Forest Research Institute) in Dehradun (right)**



Picture 6.8 (left): Insects collected using a light sheet

Picture 6.9 (right): A Japanese beetle trap

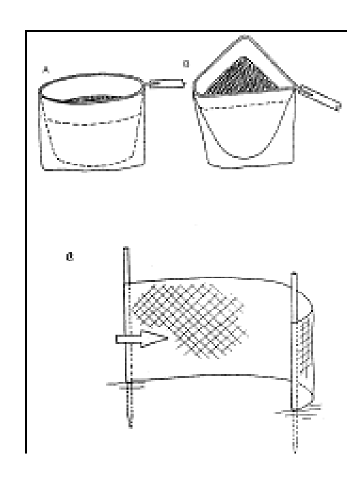


Figure 6.3: Nets used for catching aquatic insects

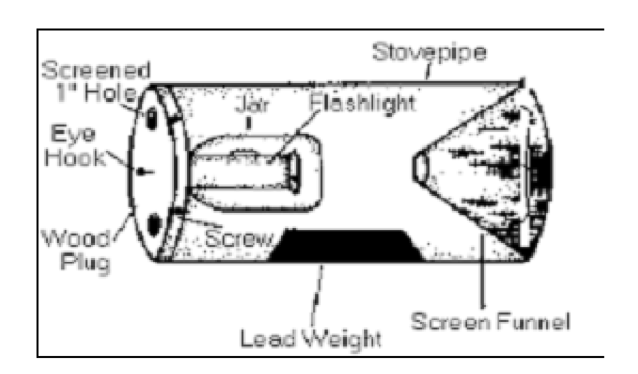


Figure 6.4: An under water light trap

Table and corresponding chart 6.1

Sl.No.	Name of the Museum and / like Institution	Location	Net used as a Mode of Collection for Insects
1	Indian Museum	Kolkata	Yes
2	Science City	Kolkata	Yes
3	Bengal Natural History Museum	Darjeeling	Yes
4	Regional Museum of Natural History	Bhubaneshwar	Yes
5	Orissa University of Agriculture and Technology	Bhubaneshwar	Not available
6	Patna Museum	Patna	No
7	National Museum of Natural History	New Delhi	Yes
8	Entomology Division, Forest Research Institute	Dehradun	Yes
9	Chhattrapati Shivaji Maharaj Vastu Sangrahalaya	Mumbai	No
10	Bombay Natural History Society	Mumbai	Yes
11	Central Museum	Nagpur	Not available
12	Government Museum	Chennai	Yes
13	Gass Forest Museum, Institute of Forest Genetics and Tree Breeding	Coimbatore	Yes
14	Butterfly Park, Bannerghatta Biological Park	Bengaluru	Yes
15	Regional Museum of Natural History	Mysore	Yes
16	Nehru Zoological Park	Hyderabad	Not available
17	Isoptera Section, Zoological Survey of India	Kolkata	No
18	Orthoptera Section, Zoological Survey of India	Kolkata	Yes
19	Coleoptera Section, Zoological Survey of India	Kolkata	Yes

